



CERN run (June 2002)

Objectives

2003 (2004?):

EM data to benchmark the simulations

2002:

- get acquainted with the environment
- get real data with current CDEs: shower profile...
- establish calibration procedure from E deposited by single-charged MIPs (muons) up (needed for GSI)



Experimental method

1 week of beam time on the H4 beam line (many thanks to CMS)

Detectors: 8 CsI crystals from AMCRYS, Ukraine
arranged in 2 crossed layers of 4
positioned on a moving table

Electronics: mostly home made
preamp + 2 sets of shaping amplifiers
low-gain "x1", high-gain "x20"
commercial CAMAC ADCs (ORTEC AD811)

Trigger: 2x2x0.2 cm³ plastic scintillator located 10m in front
of the detector. Count rate: 500-1000 Hz

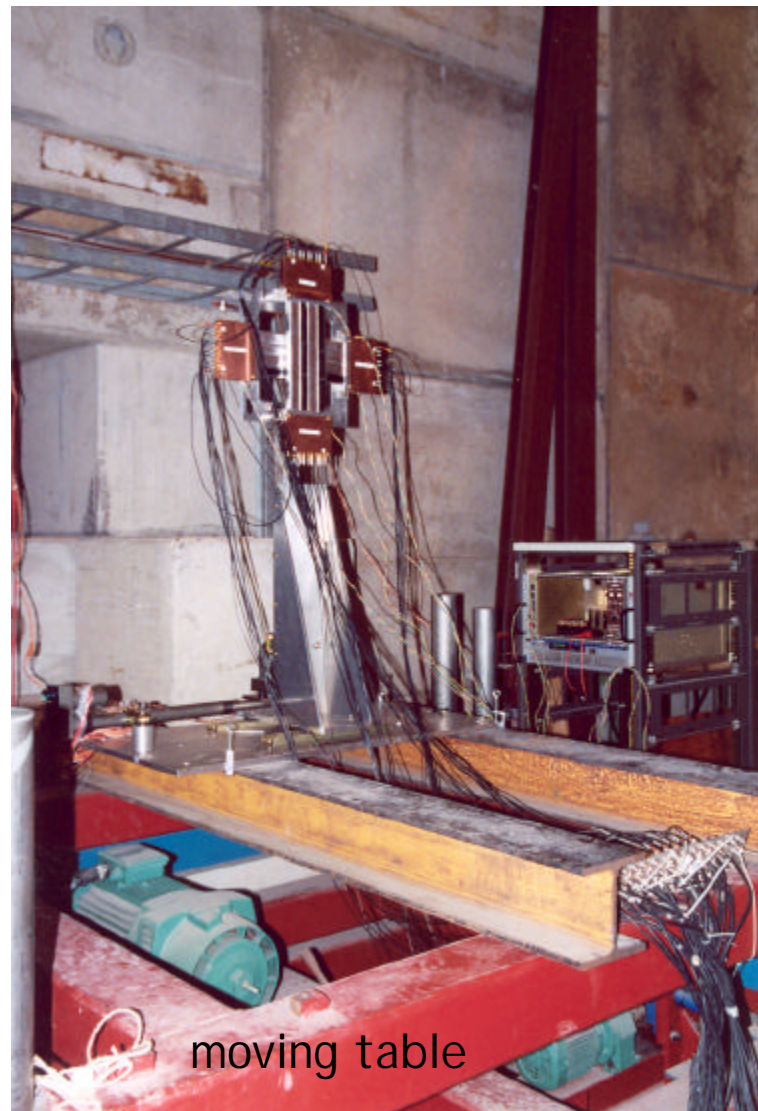
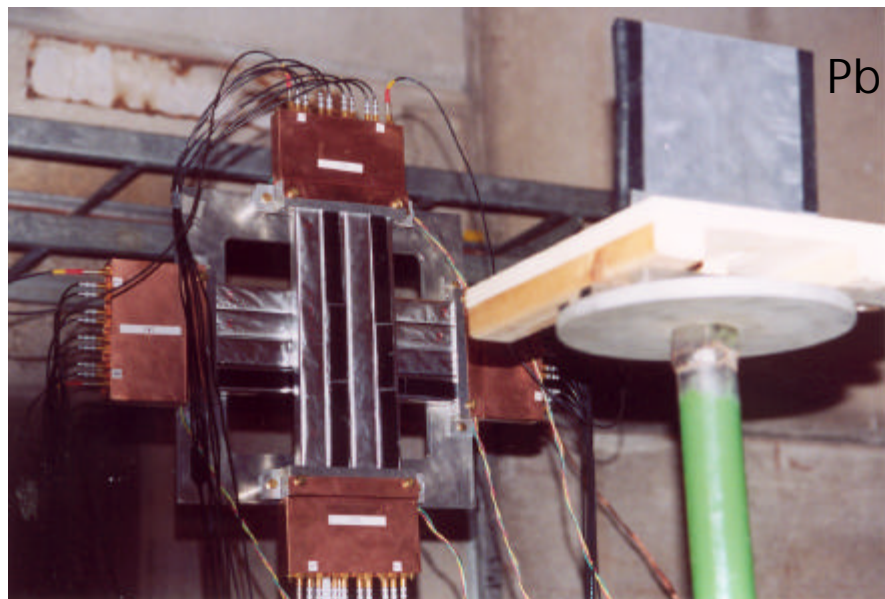
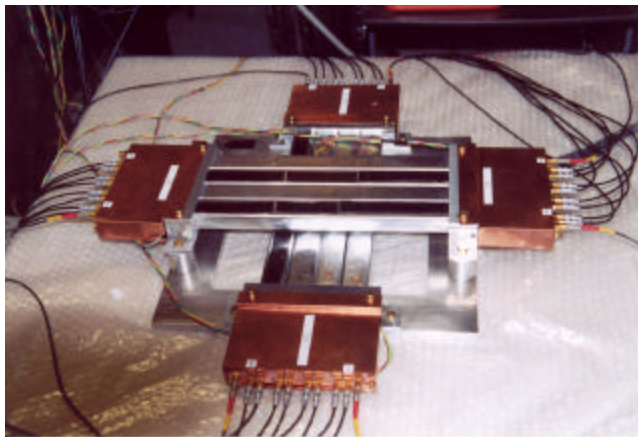
"Converter": 15x15 cm² Pb sheets of various thicknesses (.5, 1, 2 X₀)

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LLR: G. Bogaert, I. Redondo

Help from M. Haguener and J. Bourotte (LLR and CERN)

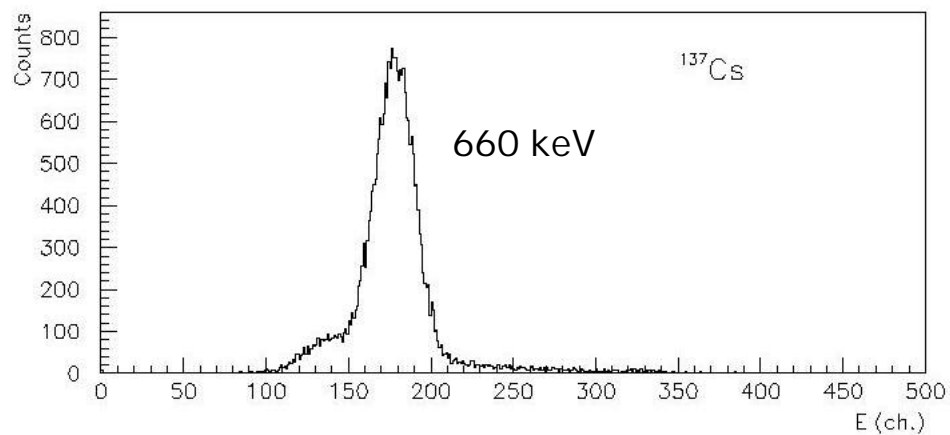
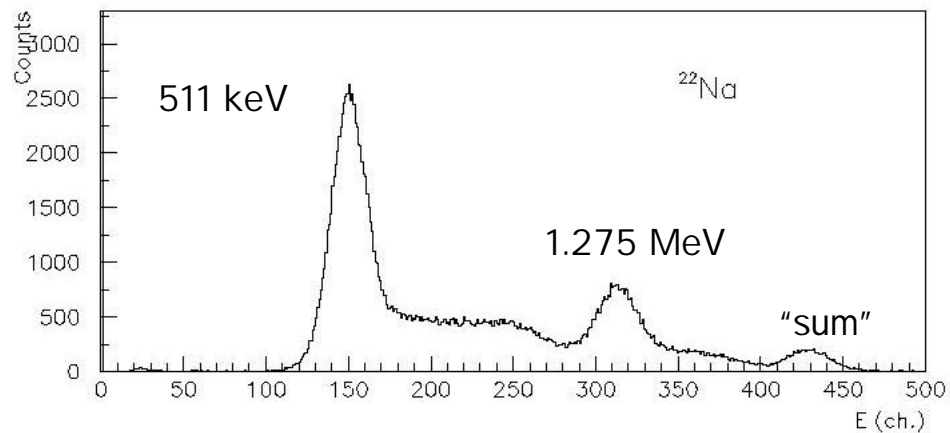


Experimental setup





Source tests



high-gain amplifier



Summary of data points

Electrons:

Energy (GeV)	30	50	100	200	280
Pb thickness	0-4 X_0 step: 2 X_0	0-11.5 X_0 step: 2 X_0	0-11 X_0 step: 1 X_0	0-11 X_0 step: 2 X_0 +8 X_0	0-11.5 X_0 step: 2 X_0
positions	2	4	2	4+18	4

Muons:

50 GeV, 2 positions



Calibration strategy

All we have for absolute calibration are muons (+source) E-deposits.
Can we use the muon data alone ($E_{\text{dep}} \sim 12 \text{ MeV}$) to establish the calibration up to tens of GeV?

Procedure:

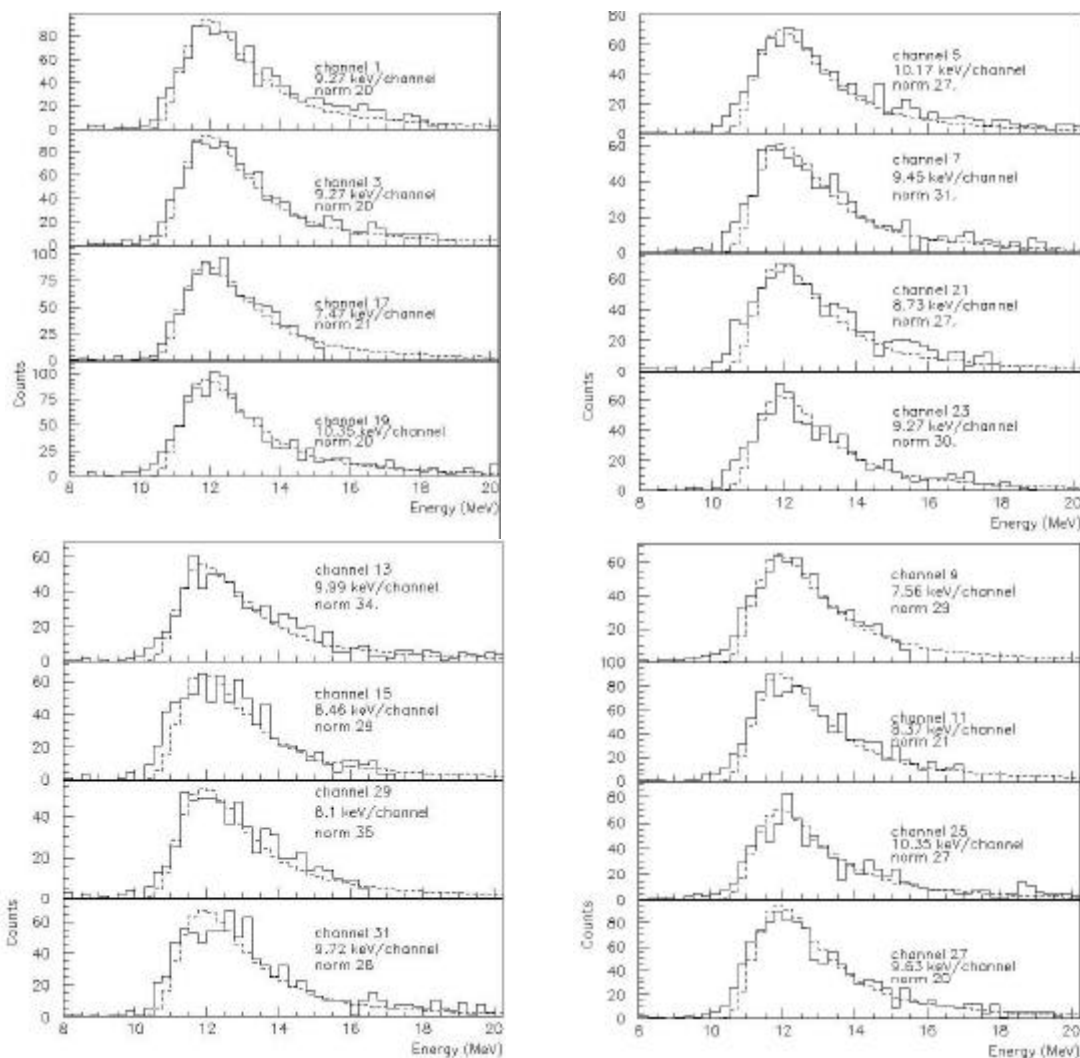
Muons in Big Diodes (BD) corrected for attenuation*
Conversion Slope for BDs with high-gain amplifiers
Pulser: relative gains between low- and high-gain amplifiers
Conversion slopes for Big Diodes with low-gain amplifiers
Small-diode vs Big-diode correlation using beam data:
Conversion slopes for Small Diodes

*attenuation coefficients: Left/Right dependence on position



Energy calibration using a 50 GeV muon beam

— data
 - - - - MC GEANT3

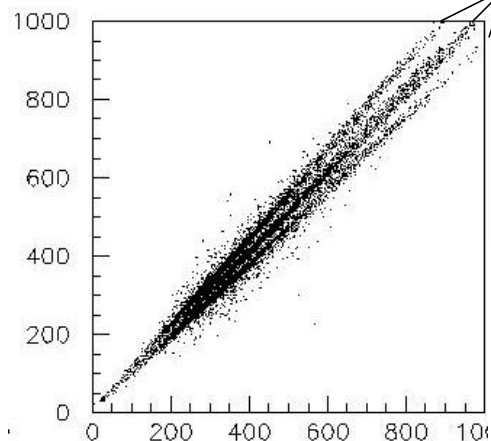




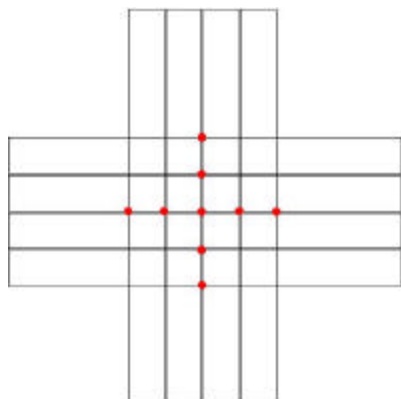
Determination of the attenuation coefficients

Right

3 of 5 positions

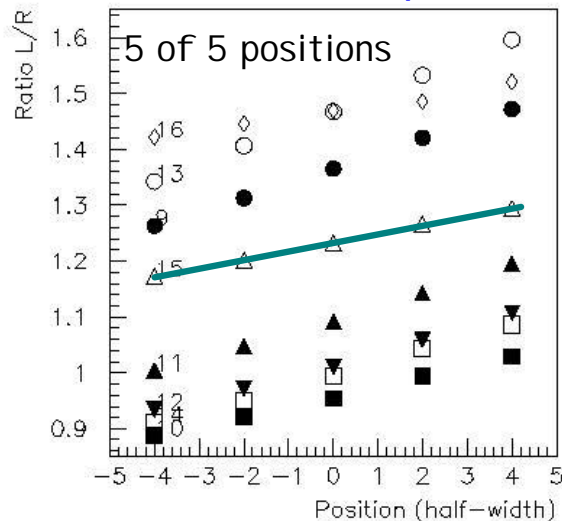


Left

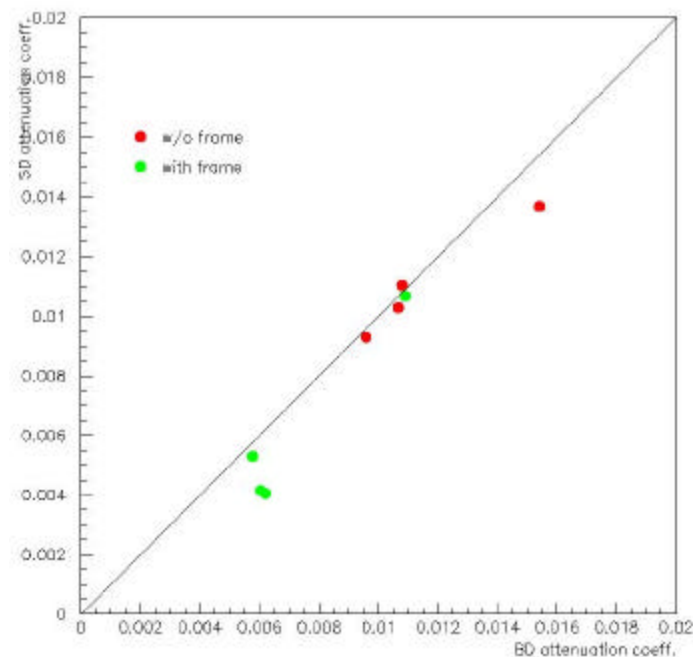


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L/R ratio vs position

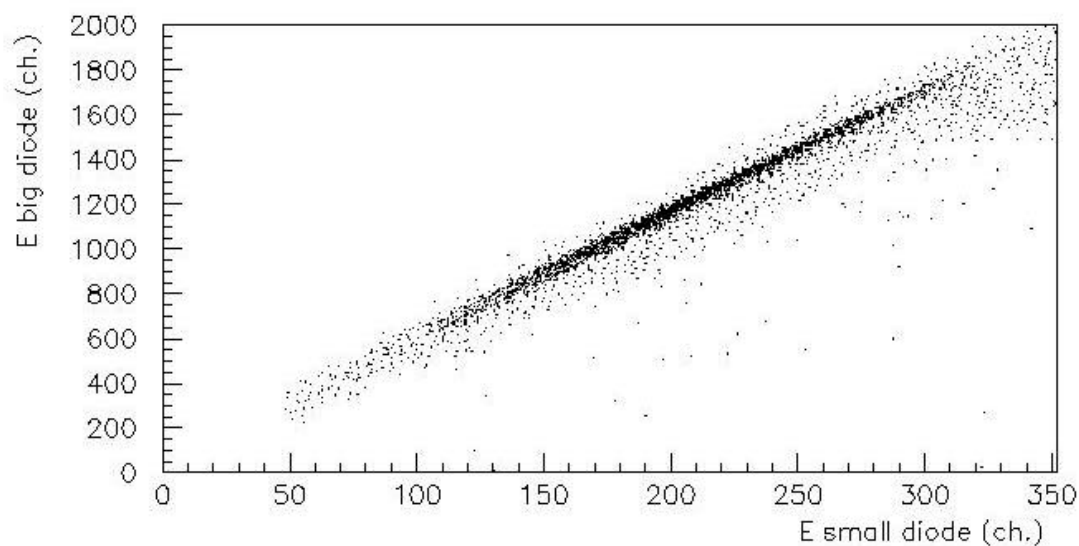
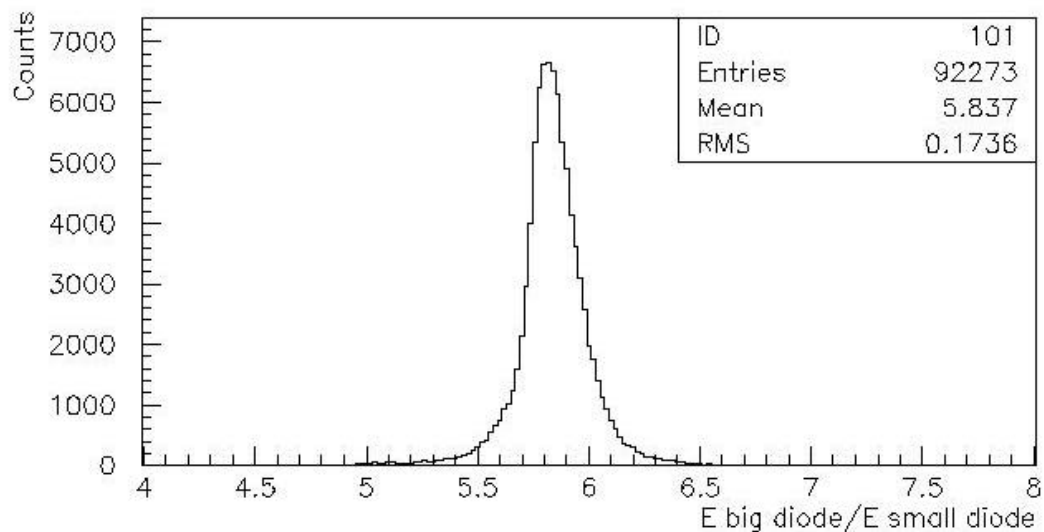


slope=attenuation coefficient





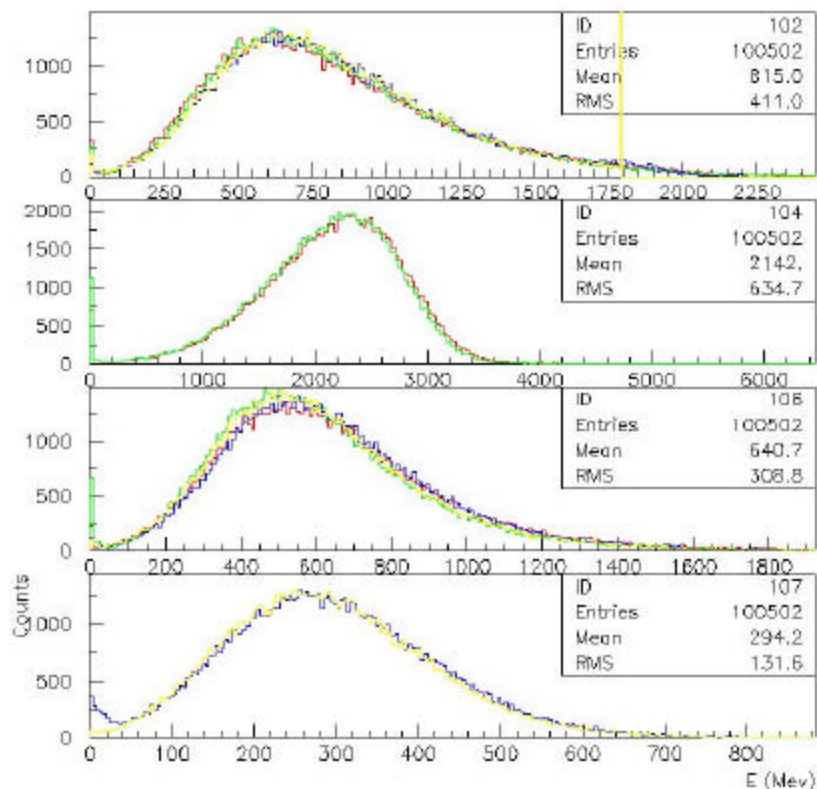
Cross calibration of small-big diodes



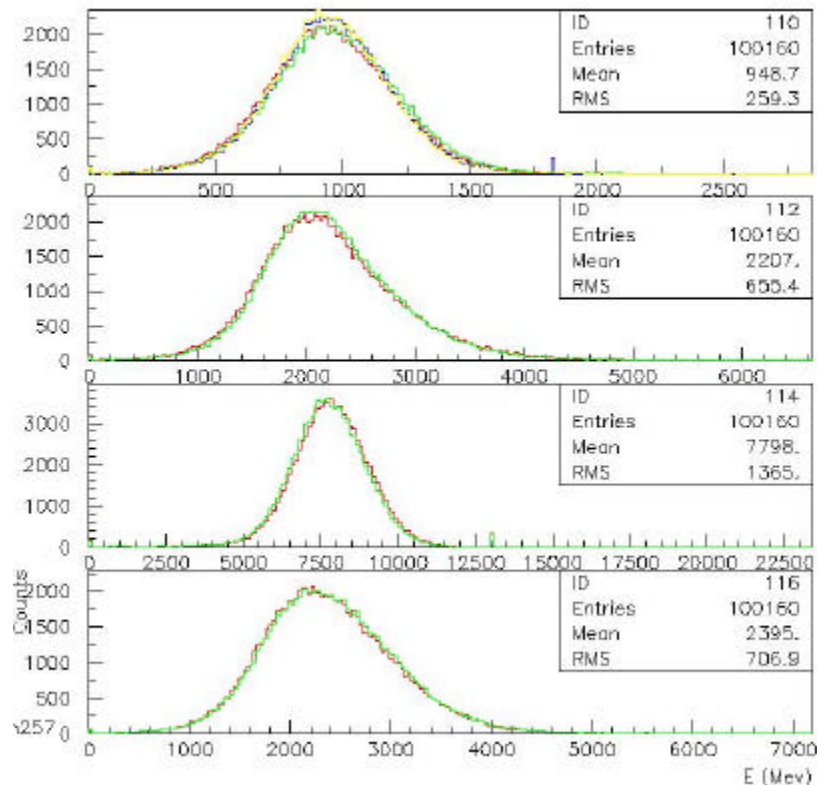


"Reconstructed" energy distributions from different ends/diodes

vertical bars



horizontal bars



One plot per bar

Colors correspond to different diodes: blue, yellow: big diodes
green, red: small diodes

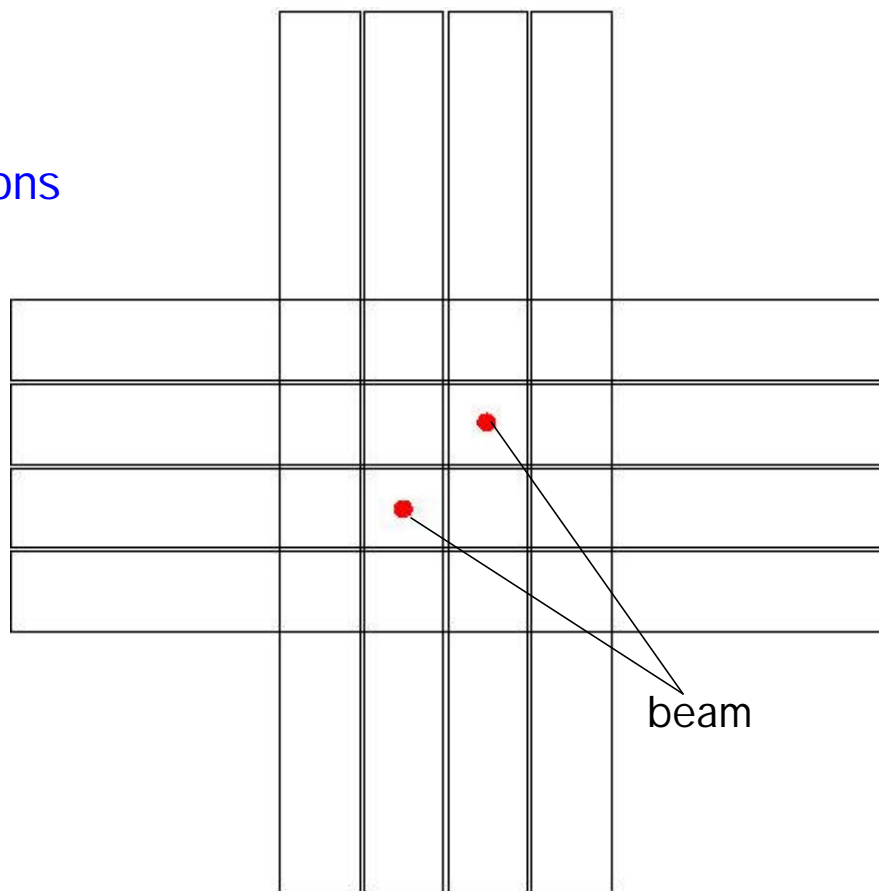
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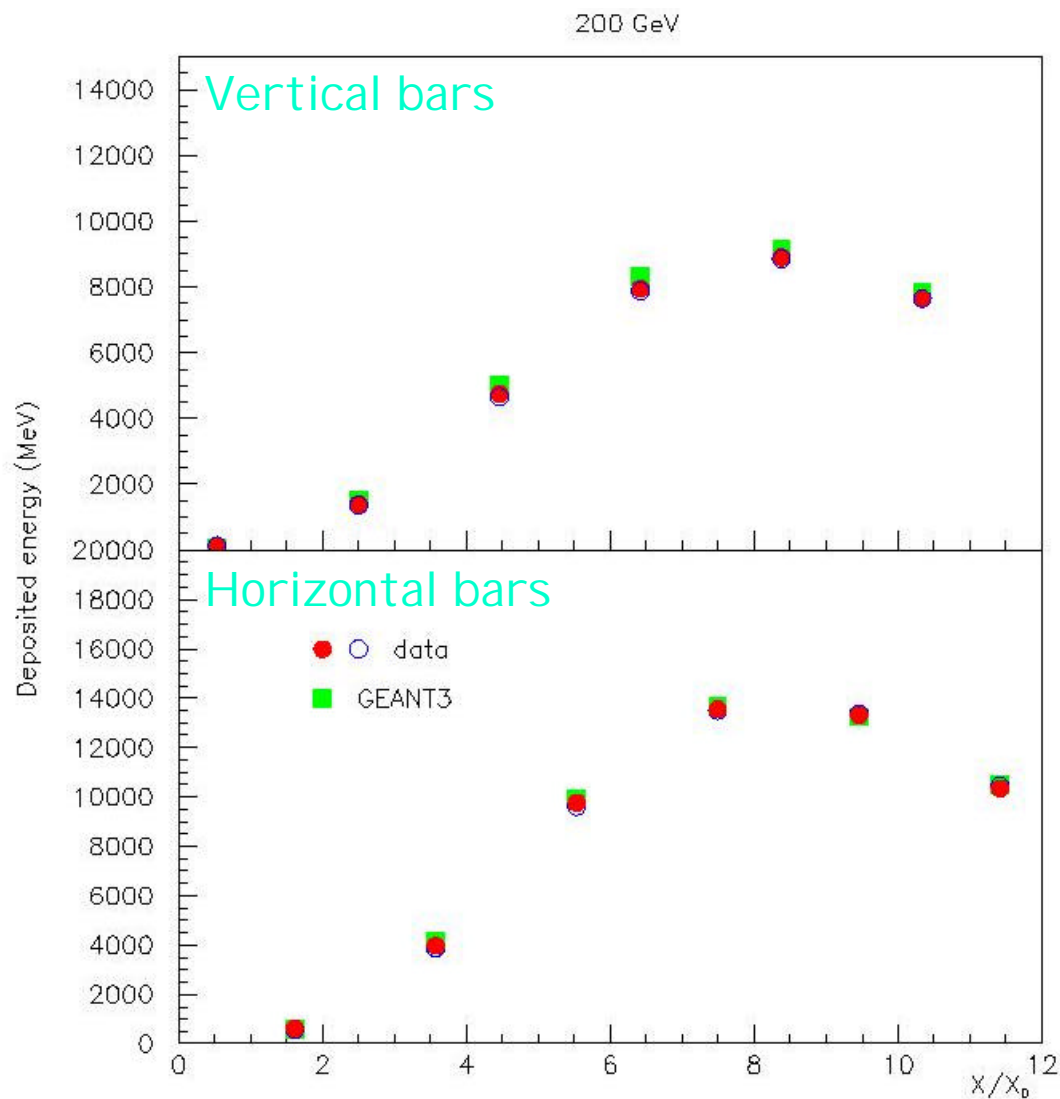
Preliminary results

Two sets of data are presented,
corresponding to different positions
with respect to the beam.



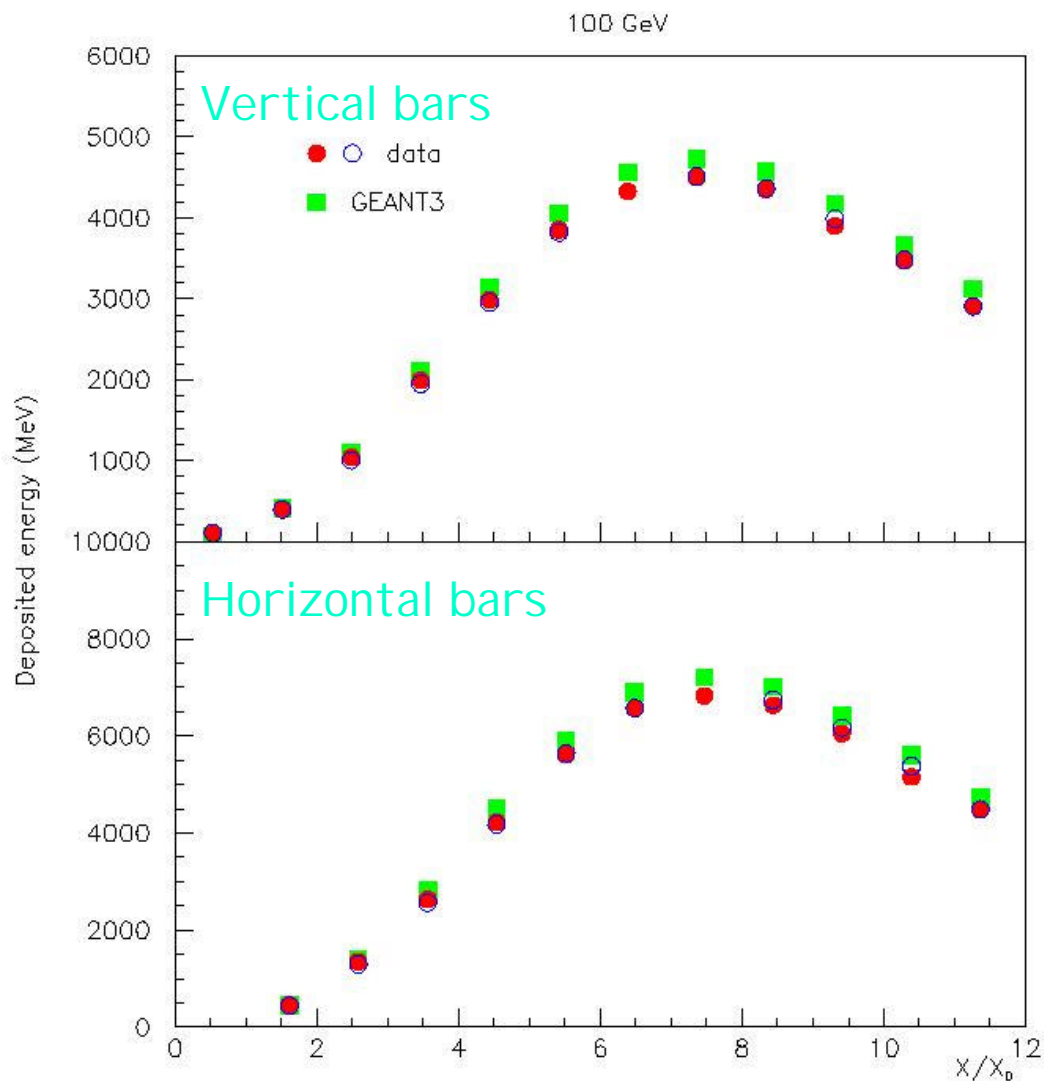


Longitudinal shower profile at 200 GeV



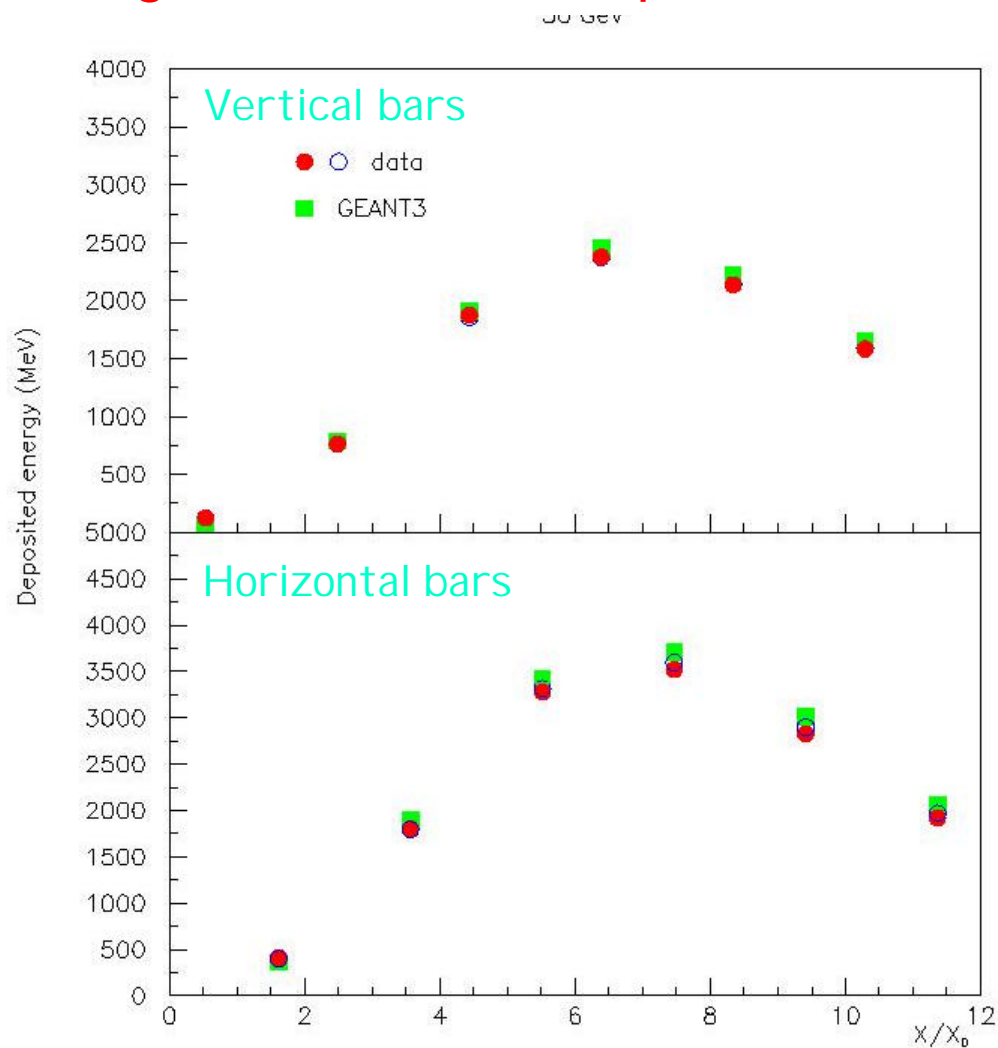


Longitudinal shower profile at 100 GeV



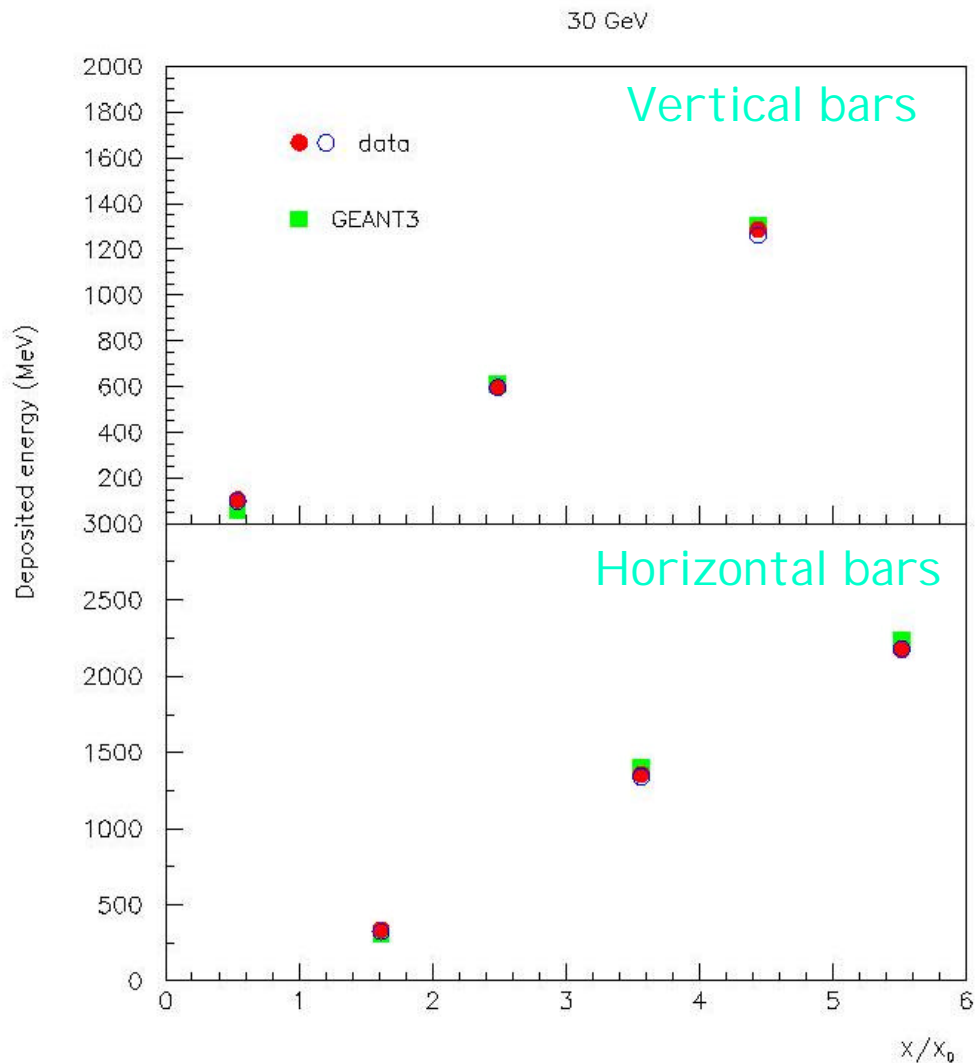


Longitudinal shower profile at 50 GeV



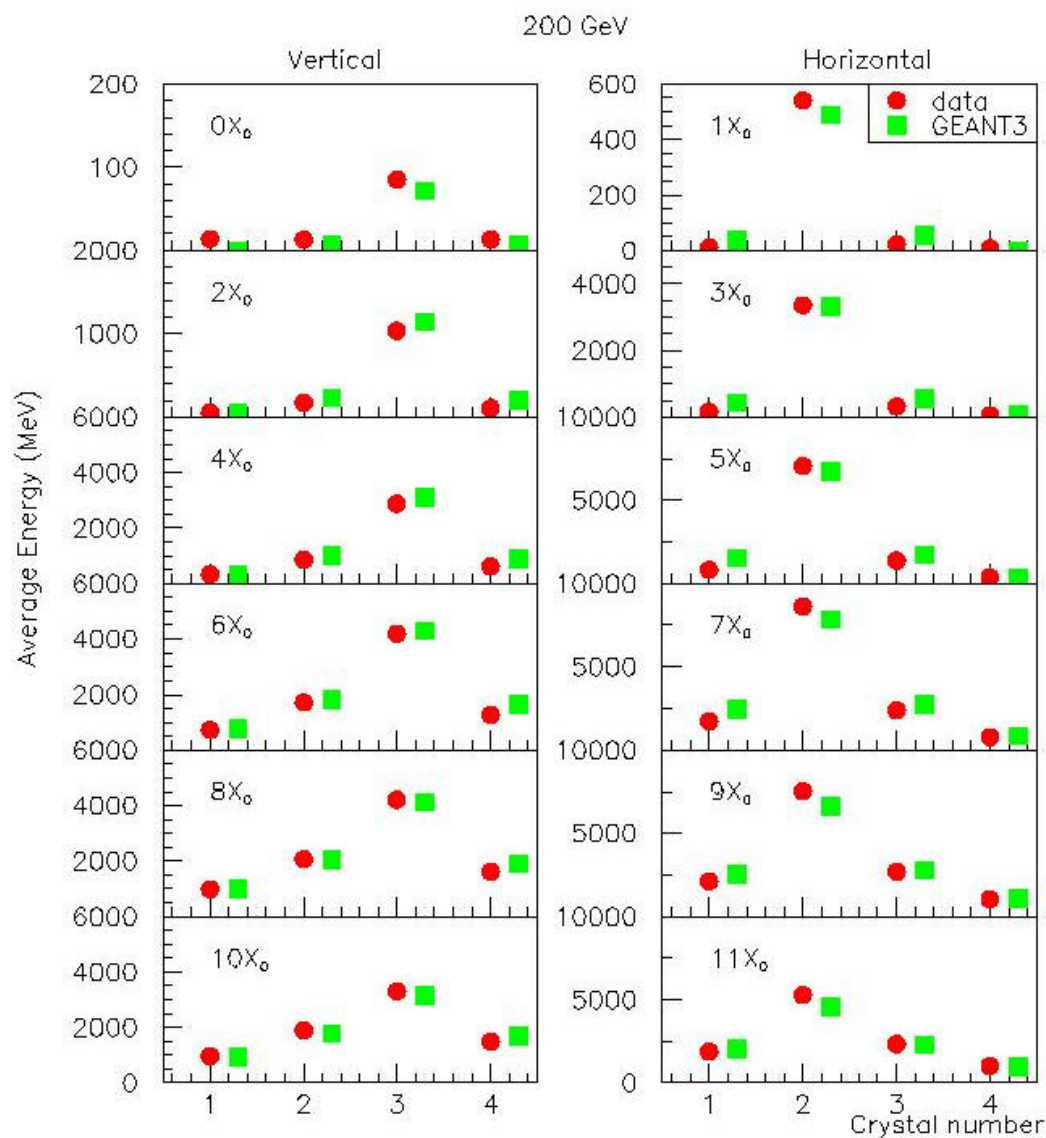


Longitudinal shower profile at 30 GeV





Transverse "shower profile" at 200 GeV





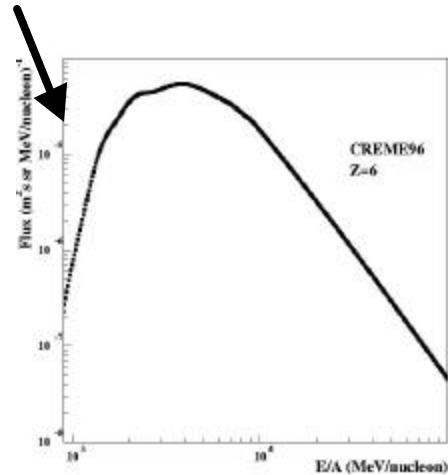
GLAST experiment in 2003 (proposal)

In-orbit calibration



Geomagnetic cutoff

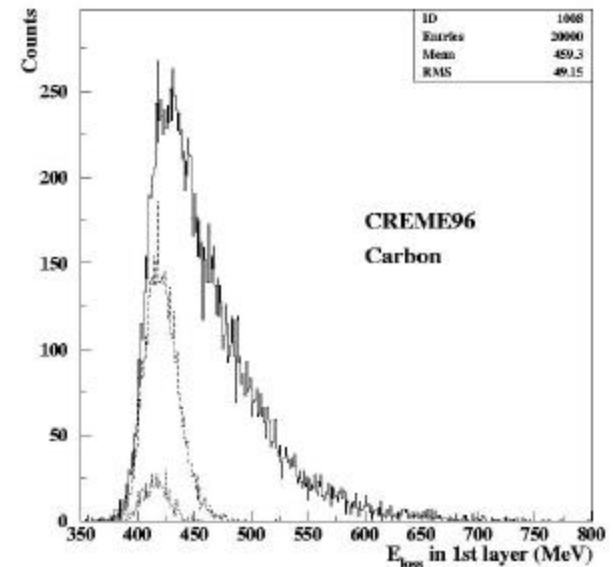
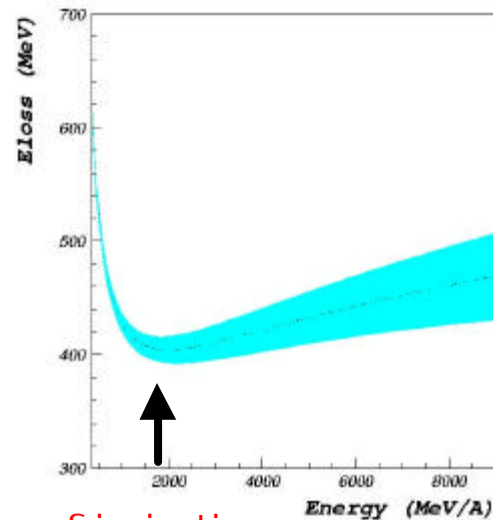
CR energy spectrum



Use of the ionisation energy
loss of cosmic-ray heavy ions

C, N, O, Mg, Si, Fe

$E_{\text{loss}}(E)$



"minimum-ionisation" peak

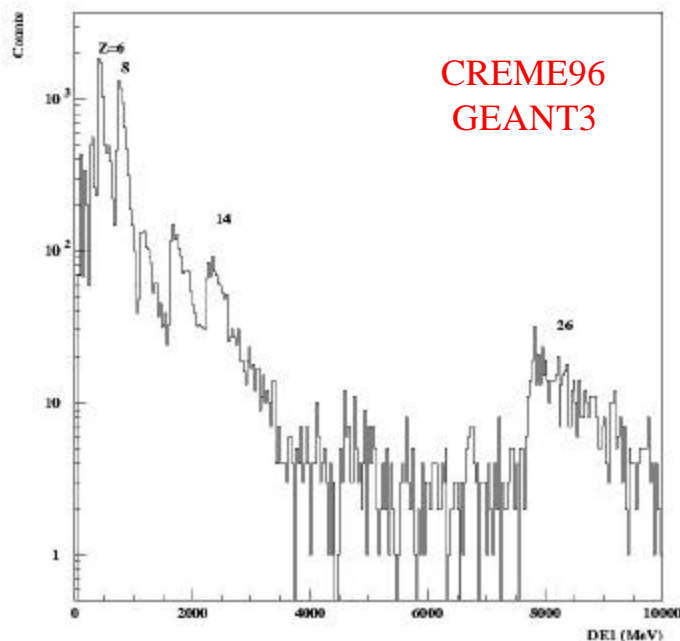
NRL 10/21/02 minimum of ionisation





In-orbit calibration (2)

Simulated energy-loss distribution



We need to:

- know the CsI light function $L(E,Z)$, non-linear because of quenching effects;
- test algorithms for rejecting reaction events (variation of Eloss between adjacent layers).



Quenching effects in CsI

High ionisation density \rightarrow non-radiative decay channel

("activation-depletion" hypothesis, exciton destruction at activator sites, recombination...)

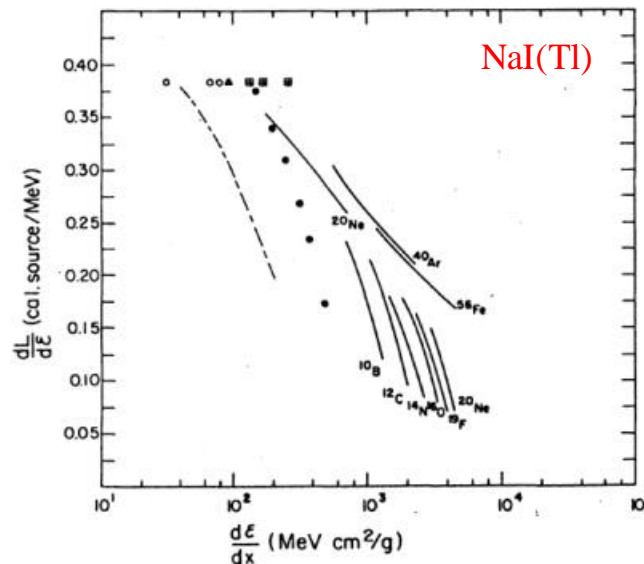
Low energy: Birk's formula

$$L(E) \propto E / (1 + k_B dE/dx) \quad k_B: \text{quenching factor}$$

High energy:

at a given dE/dx , E is higher for greater $Z \rightarrow$ more δ electrons \rightarrow less quenching

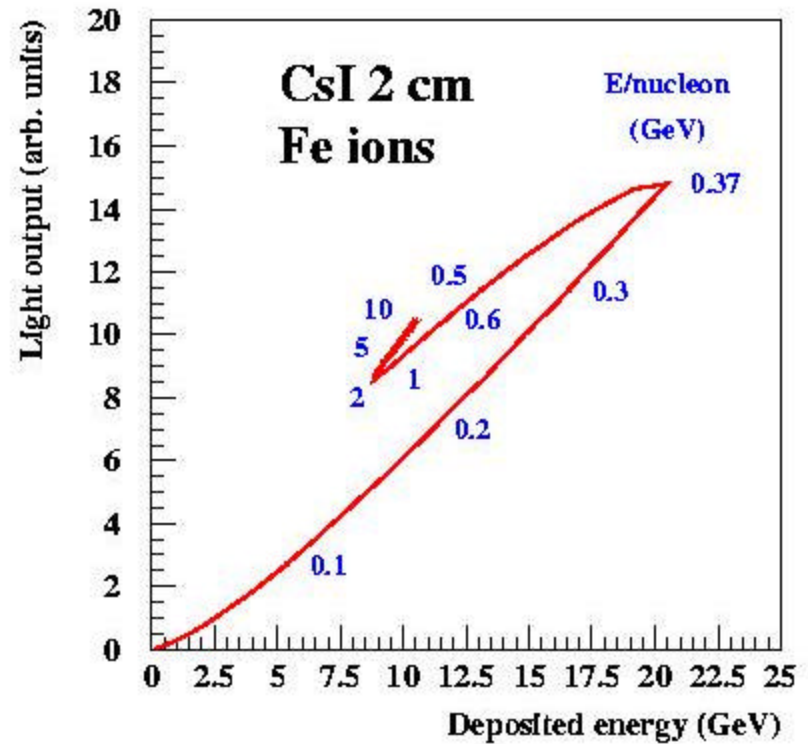
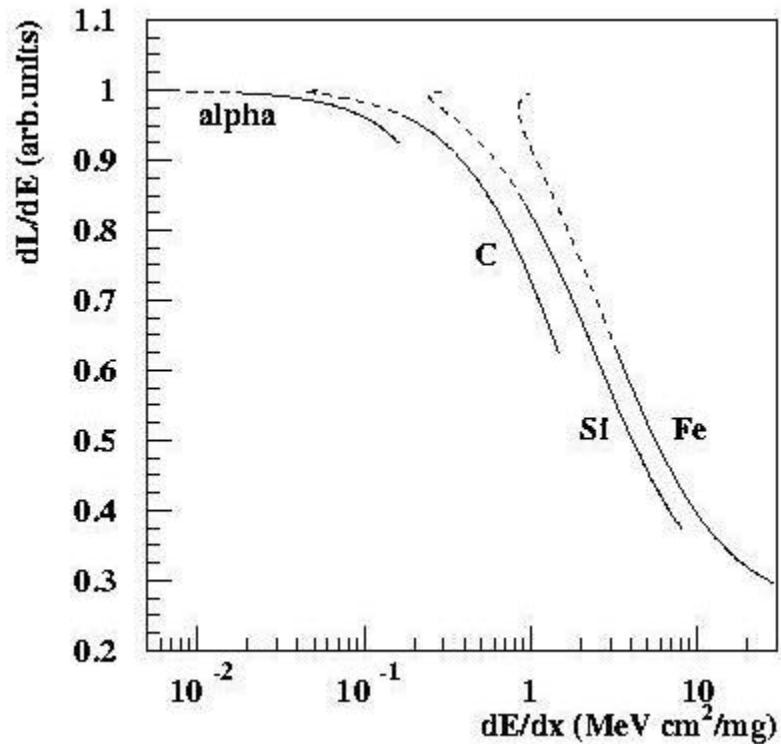
Very scarce data at high energy!



Salamon and Ahlen



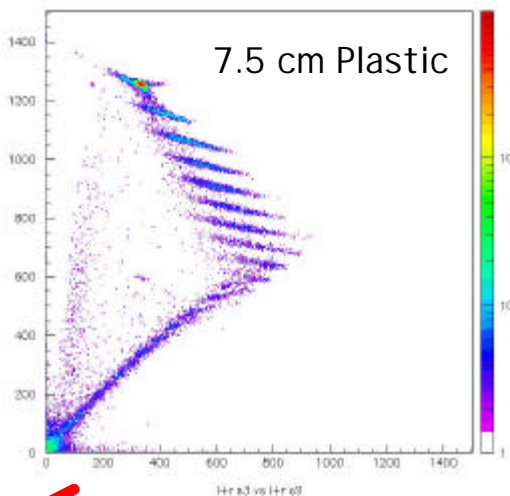
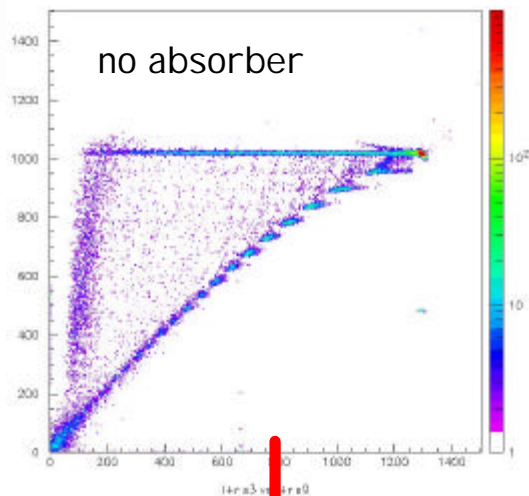
Examples of light functions



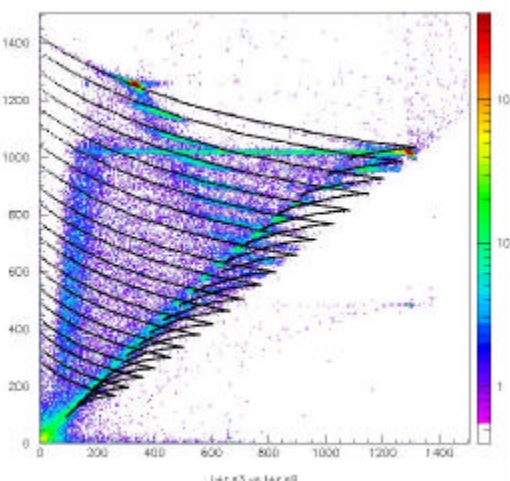
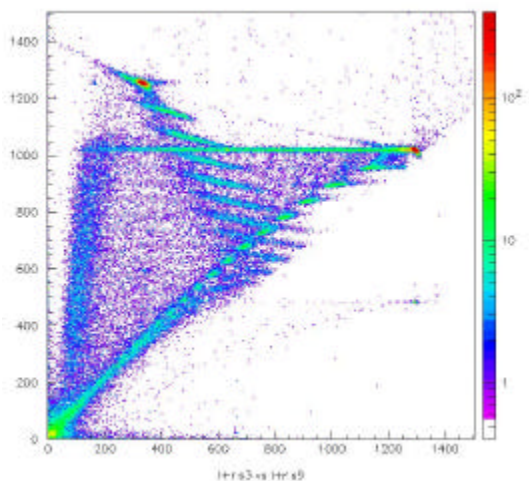
Function taken from Pârlog et al. (INDRA)
parameters adjusted from earlier GSI data



Results of previous run (S240)

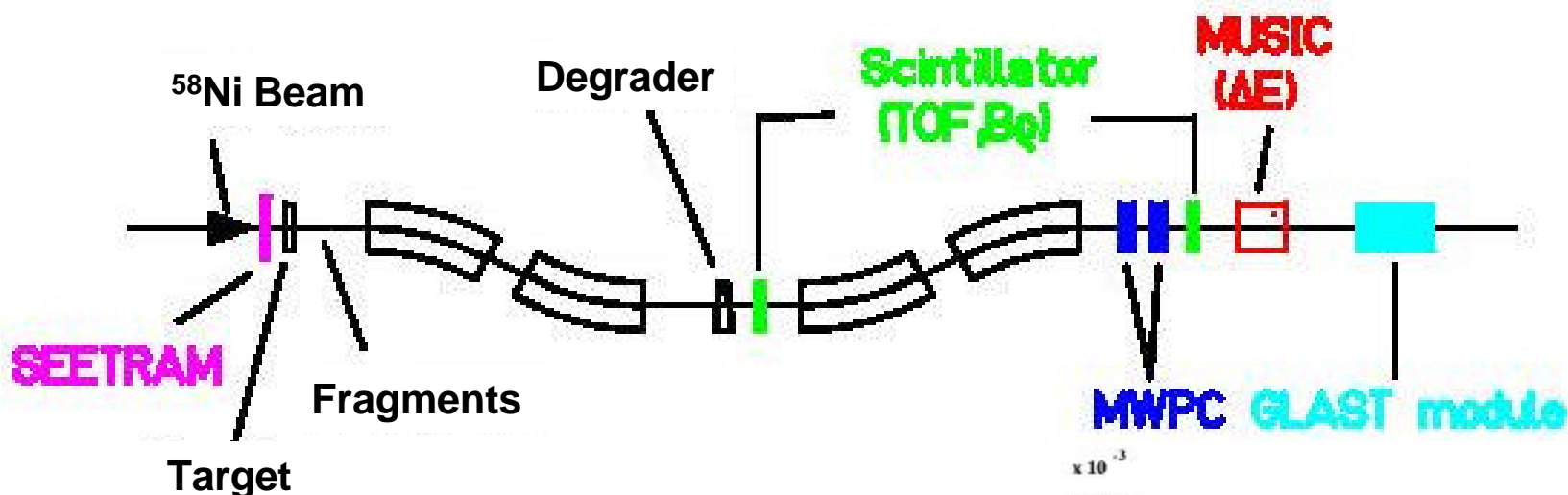


550, 700 MeV/nucleon C
700 MeV/nucleon Ni



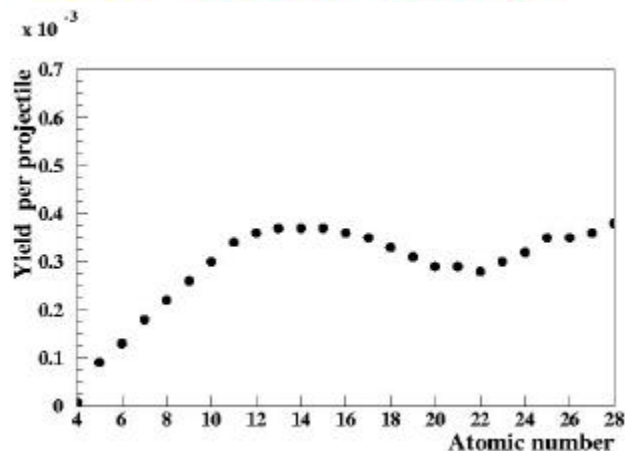


Experimental setup



One single beam: 1.7 GeV/nucleon ^{58}Ni

All fragments are produced simultaneously.
The energy is changed by varying the target thickness.
Great flexibility!





Beam time request

15 shifts (5 days) of 1.7 GeV/nucleon ^{58}Ni
in 2003 10 shifts (3.3 days) granted by the PAC

- 3 shifts at $\theta=0^\circ$
- 3X2 shifts at
 $(\theta, \phi)=(30^\circ, 0^\circ), (60^\circ, 0^\circ), (30^\circ, 30^\circ)$
- 3X1 shifts with degrader: C, Si, Fe
- 1 day of calibration of the FRS



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